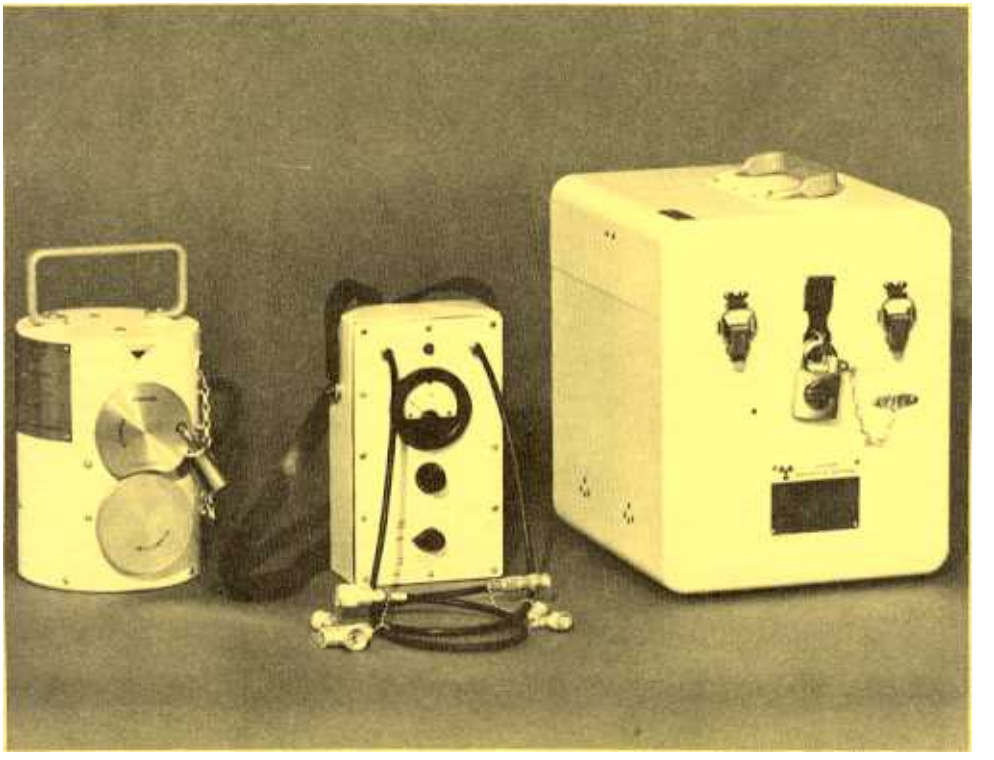
Instruction and Maintenance Manual

RADIOLOGICAL INSTRUMENT CALIBRATOR

OCD Item No. CD V-797. Model No. 1



NUCLEAR-CHICAGO CORPORATION
Subsidiary of G. D. SEARLE & CO.
Des Plaines, Illinois
1968

WARNING

THE RADIATION STANDARD COMPONENT IN THIS CALIBRATOR CONTAINS APPROXIMATELY 15 MILLICURIES OF Cs-137 FOR CALIBRATION OF THE CD V-711 REMOTE SURVEY METER. THE PRESENCE OF RADIOACTIVE MATERIAL IN THE STANDARD DICTATES STRICT ADHERENCE TO THE PRECAUTIONS AND INSTRUCTIONS IN THIS MANUAL.

THIS EQUIPMENT SHALL BE OPERATED ONLY BY PERSONS PROPERLY LICENSED BY THE ATOMIC ENERGY COMMISSION OR AN APPROPRIATE STATE LICENSING AGENCY.

UNDER NO CONDITIONS ARE OPERATING PERSONNEL TO ATTEMPT ANY INTERNAL ADJUSTMENTS OR REPAIRS TO THE RADIATION STANDARD OTHER THAN THE BASIC TROUBLESHOOTING OPERATIONS INCLUDED IN SECTION 5 OF THIS MANUAL.

THE SOURCE CAPSULE USED IN THE RADIATION STANDARD IS OF THE DOUBLE ENCAPSULATED STAINLESS STEEL TYPE, WITH THE ACTIVITY HELD IN A GLASS BEAD MATRIX. THESE CAPSULES HAVE BEEN TESTED AT A TEMPERATURE OF 1000° F. HOWEVER, IN THE EVENT OF A FIRE, PERSONNEL OVEREXPOSURE, RELEASE OF RADIOACTIVE MATERIAL OR OTHER ACCIDENT, AS DESCRIBED IN TITLE 10 OF THE CODE OF FEDERAL REGULATIONS, PART 20, PAR. 20.402, 20.403, AND 20.405, IMMEDIATELY NOTIFY THE FOLLOWING BY TELEPHONE OR TELEGRAPH:

1. THE DIRECTOR OF THE APPROPRIATE AEC REGIONAL COMPLIANCE OFFICE AS GIVEN IN APPENDIX D, TITLE 10, PART 20 OF THE CODE OF FEDERAL REGULATIONS, OR THE APPROPRIATE STATE LICENSING AGENCY.
2. NUCLEONICS DIVISION, TECHNICAL SERVICES, OFFICE OF CIVIL DEFENSE, DEPARTMENT OF THE ARMY, PENTAGON, WASHINGTON, D.C. 20310. PHONE: AREA CODE 202, 695-2519.
3. RADIOLOGICAL DEFENSE OFFICER OF THE APPROPRIATE OCD REGIONAL OFFICE.

THE RADIATION STANDARD SHALL BE WIPE TESTED AT INTERVALS NOT TO EXCEED SIX (6) MONTHS, IN ACCORDANCE WITH RADIOLOGICAL SAFETY INSTRUCTIONS PROVIDED IN SECTION 2.2 OF THIS MANUAL.

THE RADIATION STANDARD MUST BE PADLOCKED WHEN UNATTENDED. INSTRUCTIONS FOR LOCKING ARE PROVIDED IN SECTION 3.3 OF THIS MANUAL, AND MUST BE FOLLOWED.

WHEN IN STORAGE, THE RADIATION STANDARD SHALL BE INSPECTED AS FOLLOWS AT INTERVALS NOT TO EXCEED SIX (6) MONTHS:

1. SURVEY THE CRATED (IN STORAGE CONTAINER) RADIATION STANDARD WITH A CD V-700 TYPE METER. IF EXPOSURE RATES AT THE SURFACE EXCEEDING 2 MR/HR ARE FOUND, TAKE IMMEDIATE CORRECTIVE ACTION IN ACCORDANCE WITH SECTION 2.2.5 OF THIS MANUAL.
2. A WIPE TEST SHALL BE MADE IN ACCORDANCE WITH SECTION 2.2 OF THIS MANUAL UNLESS SPECIFICALLY WAIVED BY THE LICENSE.

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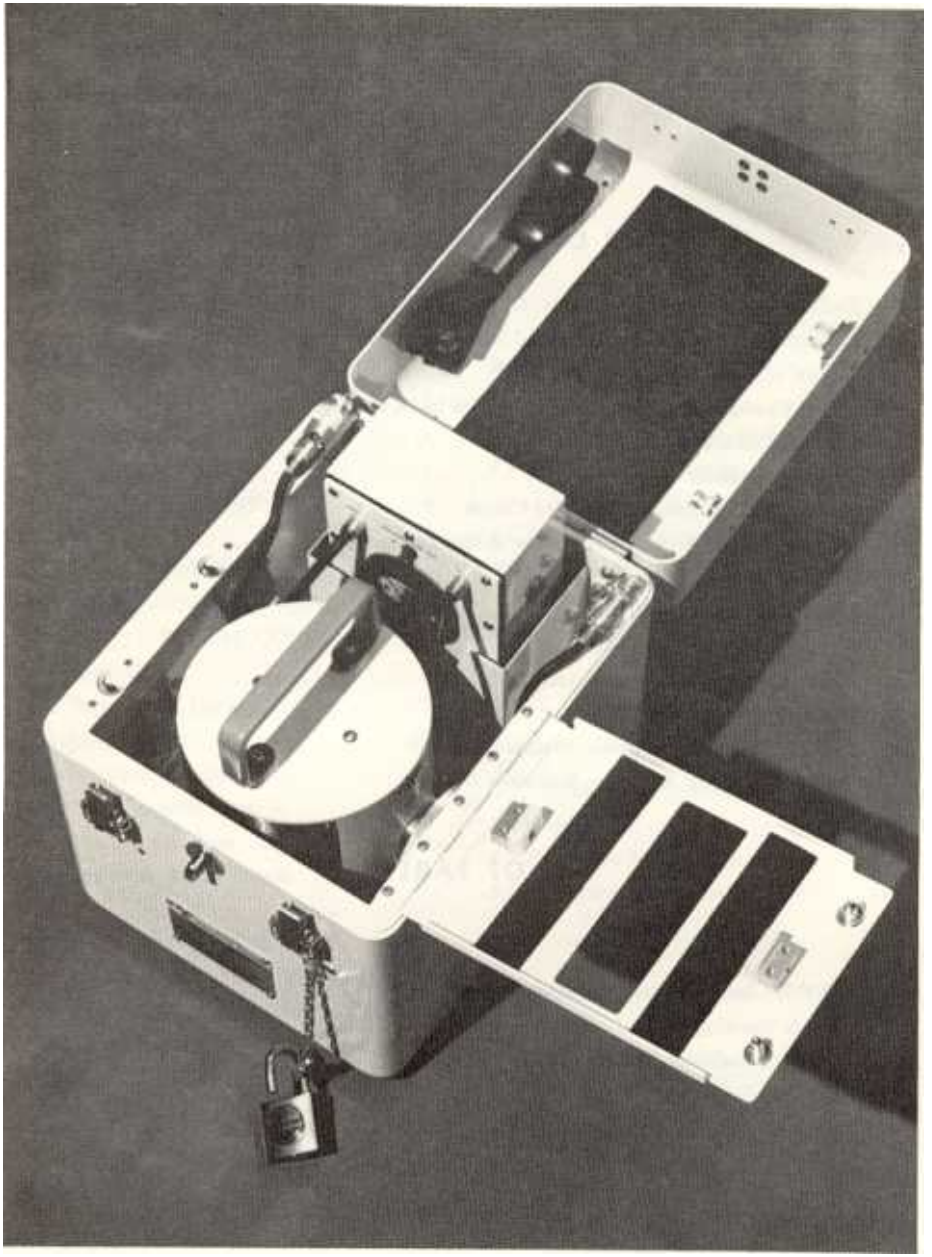


Figure 1.1 Radiological Instrument Calibrator
OCD Item CD-V-797 Model No. 1

SECTION 1.0
EQUIPMENT DESCRIPTION

1.1 GENERAL

1.1.1 The Model CD V-797 Calibrator shown in figure 1.1 comprises two assemblies. These are (1) a CS-137 radiation standard designed to calibrate the 1 r/hr range of CD V-711 Models 2, 2A, Mark III, and Mark IV; and (2) a detector signal simulator designed to check range agreement and sensitivity of CD V-711 Models 2, 2A, and Mark IV.

1.1.2 Due to variations in the amount of radioactive material used in each radiation standard, the assembly has been individually calibrated and marked with a standardized r/hr value.

1.2 REFERENCE DATA

Nomenclature: Radiological Instrument Calibrator CD V-797 Model 1.

Contract Number and Date: OCD PS-65-187, dated July 1, 1965.

Contractor: Nuclear-Chicago Corporation, 333 East Howard Avenue, Des Plaines, Illinois 60018.

Cognizant Inspector: DCSR, O'Hare International Airport, Illinois.

Shipping Weight: 50 pounds.

Radiation Source: Cesium 137 (purity 99%).

Source Activity: 15 millicuries ±10%, as of the date stamped on the radiation standard.

Half Life of Radioactive Material: 29.6 years.

External Exposure Rate (Storage Condition): Not more than 2.0 mr/hr at surface of storage container.

Calibrator Design: Complies with Military Specification MIL-E-16400 (SHIPS) dated June 1, 1965.

Equipment Supplied: The calibrator is supplied with two cable adapters, an instruction manual, one radiation standard, and one simulator in a locked storage/shipping container, as shown in figure 1.2.

1.3 FUNCTIONAL OPERATION

1.3.1 Component parts of the radiation standard are shown in figure 6.1. The CS-137 source (24) is contained in a spherical densalloy shield which may be rotated within a second shield assembly (21). The source holder shield is supported on its axis of rotation by nylon bearings (27) and collars (15, 28). A ball vlier (19) and detent are used to locate the source in either the Standardize or Storage position. Configuration of the system is illustrated in figure 1.3. The radiation standard is used to calibrate the 1 r/hr range of a CD V-711 unit. Proper polarizing potential is indicated by a reading within the red scale area of the simulator meter. The POLARIZATION POT switch must be set at + when testing CD V-711 Models 2 and 2A. or at − when testing Mark IV instruments.

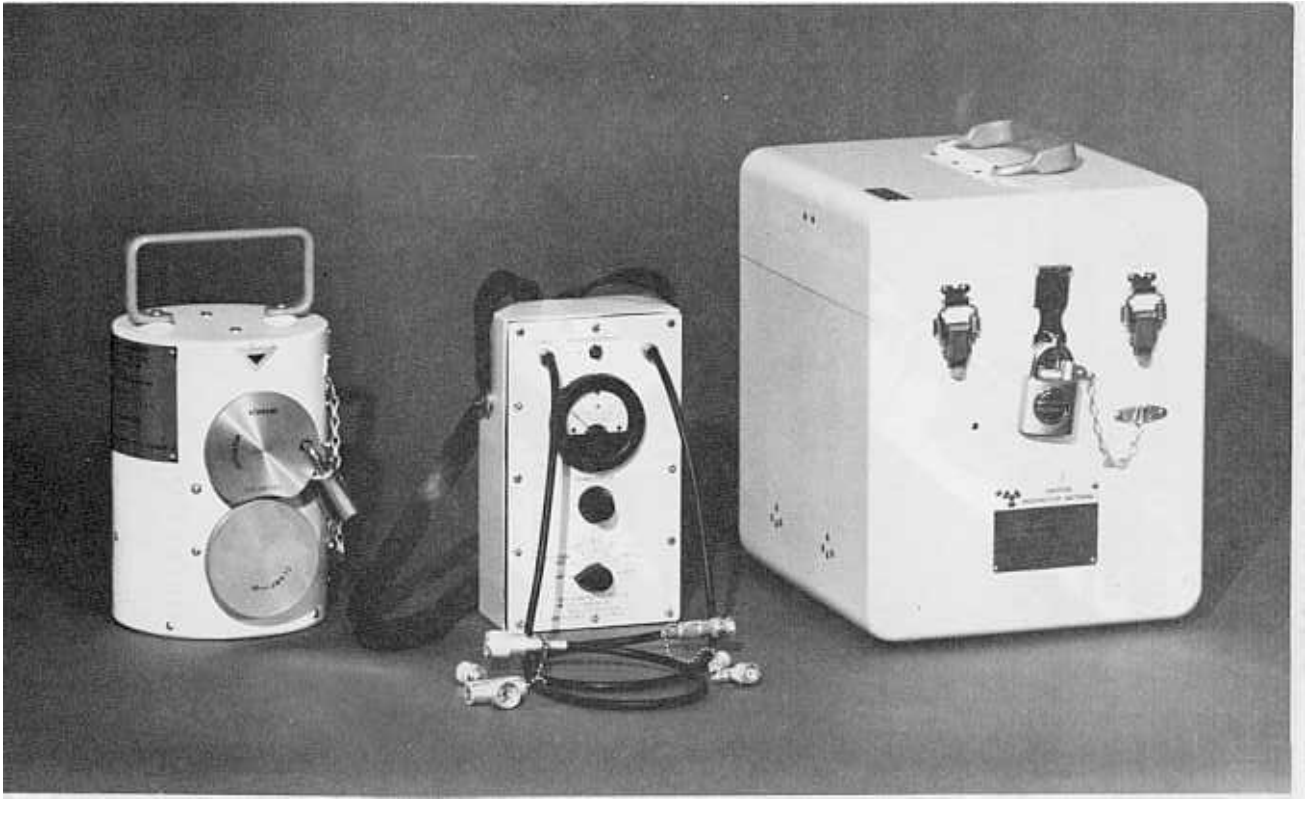


Figure 1.2 Principle Components of Radiological Instrument Calibrator, OCD Item CD-V-797 Model No. 1

1.3.2 A standardize control is provided on the simulator to adjust its current output for a ½ scale meter reading on the CD V-711 unit being tested. Range multiplication resistors are tested by applying decade multiples of current to the CD V-711 metering unit and observing the meter reading. Both direction and magnitude of the range resistor tolerance is determined by a comparison of scale readings with one obtained in the STD position of the simulator assembly.

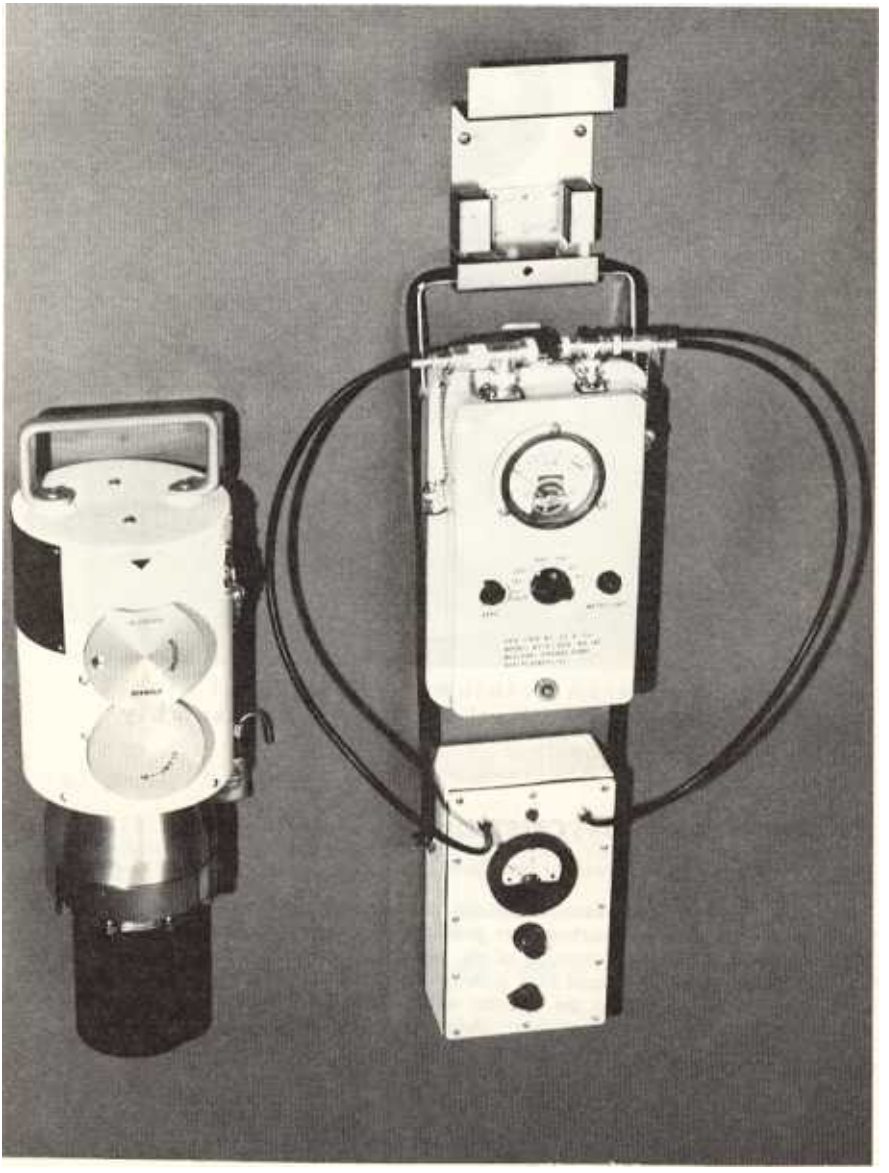


Figure 1.3 System Configuration for Calibrator Applied to OCD CD-V-711

Figure 1.4 Radiation Standard Assembly

1.4 COMPONENT DESCRIPTION

1.4.1 Radiation Standard (see figure 1.4).

1.4.1.1 To prevent accidental exposure of the operator to Cs-137 radiation, two mechanical interlocks are provided. Spring loaded locking bars (9 and 32 in figure 6.1) prevent rotation of the source from its storage position until the radiation standard is placed over a detector assembly. Clamp knob (3) forces a rubber pressure pad against the detector wall to prevent removal from the detector in the calibrate position.

CAUTION

THE CLAMP KNOB MUST BE ENGAGED WITH THE ACTUATOR KNOB BEFORE INSERTING THE DETECTOR HOUSING, IN ORDER TO PREVENT DAMAGE TO THE DETECTOR OUTER SURFACE.

1.4.1.2 Padlocks are provided on both the shipping container and the actuator knob. The standard is designed to be used with CD V-711 Detector Assemblies, Models 2, 2A, and Mark III. An initial reference reading in the range of 0.6 to 0.95 r/hr is obtained from the standard.

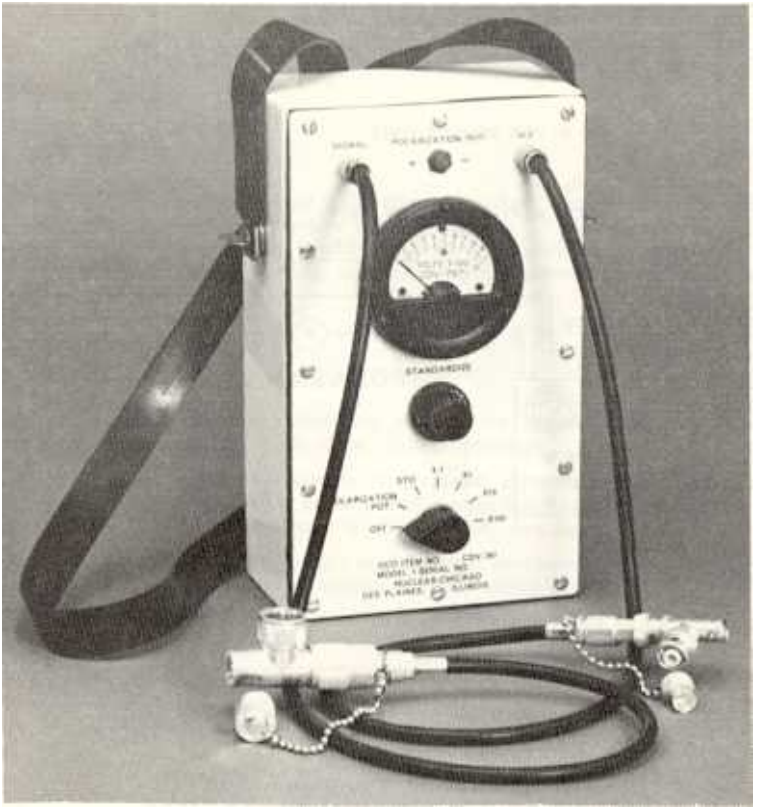


Figure 1.5 Detector Simulator Assembly

1.4.2 Simulator Description

1.4.2.1 The simulator assembly, shown in figure 1.5, is contained in a water-right gasketed enclosure designed for field operation. The following controls are mounted on the panel.

1.4.2.1.1 An operation selector switch, used to select appropriate signal current or to monitor polarization potential.

1.4.2.1.2 A standardize potentiometer, used to adjust simulated signals for a specific set of calibration resistors.

1.4.2.1.3 A polarize potential switch, used to monitor either positive or negative detector polarization potentials.

1.4.2.2 In addition to the controls, two cables are brought out for connection to the CD V-711 monitor assembly. One cable is marked Signal, and the other is marked HV. A pair of Tee connectors is provided to permit testing of ion chamber insulation and cable leakage.

1.4.2.3 Operation of the simulator is illustrated in figure 1.6. Potential divider RM and R1 form a current source which can be adjusted in decade multiples. Precision resistor Rs is used as a comparison standard for the CD V-711 hi megohm input resistors. The potential drop is indicated on the CD V-711 meter.

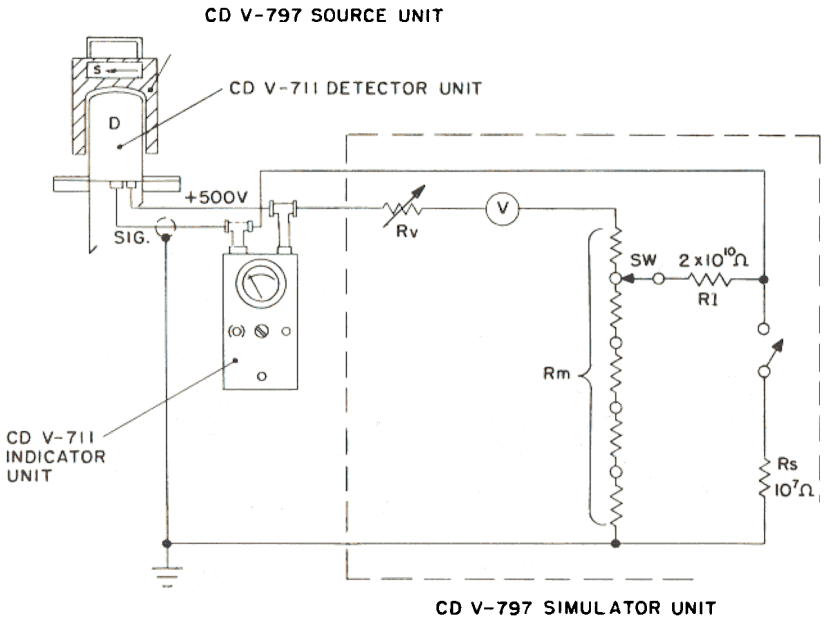


Figure 1.6 Calibration Connections, Simplified Circuit

1.4.3 Storage and Shipping Container

1.4.3.1 A shipping and storage container is provided, in compliance with shielding and transport requirements. See figures 1.1 and 1.2. This container incorporates additional lead shielding to reduce surface radiation levels to 2 mr/hr or less. The container will accommodate the radiation standard, simulator and cables, two Tee adapters, and the instruction manual. It is constructed of aluminum alloy and is padded and braced to withstand the requirements of Specification MIL-E-16400. External surfaces of the container display the following information:

A. CD V-797 Model 1 Serial No. _____.

B. Contract Number OCD-PS-65-187.

C. Office of Civil Defense.

D. Nuclear-Chicago Corporation, Des Plaines, Illinois.

E. Caution Radioactive Material, with standard radiation symbol.

F. CS-137 15 mc Date _____.

G. Bureau of Explosives Permit No. 520.

H. Class "D" Poison Label, Group I or II.

SECTION 2.0
OPERATING AND HANDLING

2.1 GENERAL

2.1.1 During the normal calibration procedure recommended for use with the CD V-797, the operator is exposed to potential hazards. To minimize these hazards, it is necessary that the operator be familiar with the precautionary measures included in this section. Potential hazards relating to the calibration procedures are radiological and/or electrical in nature.

2.2 RADIOLOGICAL HAZARDS

2.2.1 Three potential radiological hazards are related to the 15 millicurie Cs-137 source located in the spherical shield of the radiation standard.

2.2.1.1 There is a danger of personnel exposure during the standardization process. Personnel must be cautioned against standing closer than three feet from the CD V-711 detector when it is pipe mounted. See figure 2.1.

2.2.1.2 There is a danger of radioactive contamination which would be caused by the escape of radioactive material from the source capsule.

2.2.1.3 Fire or mechanical damage can cause a loss of the effective shielding provided for the assembly.

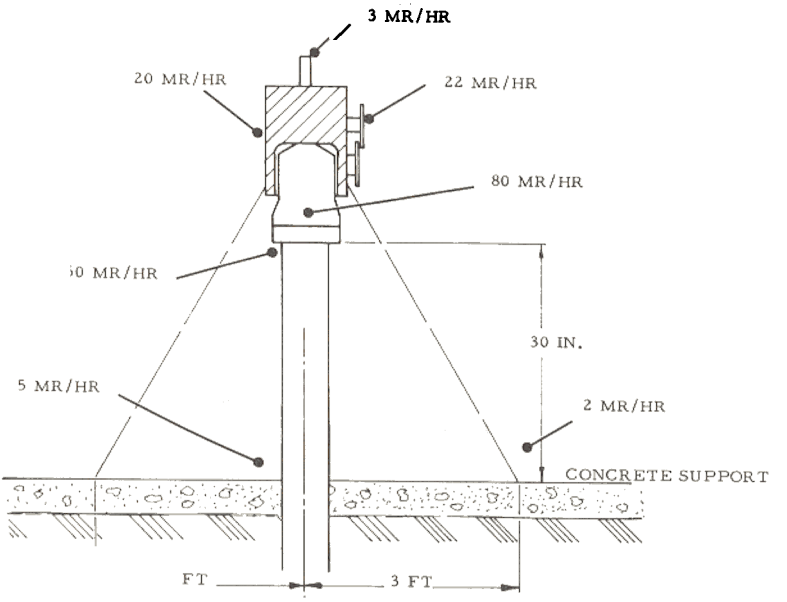


Figure 2.1 Radiation Levels Around Source Unit in Standardize Position

2.2.2 Although the radiation standard is designed to minimize the possibility of accidental operator exposure, a significant amount of scattered gamma radiation is present under the ionization chamber during a field calibration procedure. It is therefore essential that the operator observe the safety precautions given below.

2.2.3 Personnel monitoring equipment (e.g., film badge or CD V-138 pocket dosimeter) must be supplied to each calibrator operator and utilized in accordance with procedures established by the cognizant health physicist or radiation protection officer. These procedures must satisfy the requirements of Title 10, Part 20 of the Code of Federal Regulations.

2.2.4 Precautionary Procedures

2.2.4.1 The external radiation hazard is controlled by the shield and interlock when the radiation standard is in storage condition. Store the standard in the storage container provided to limit the external radiation level to less than 2 mr/hr. This container is marked properly for radioactive material storage.

2.2.4.2 The following procedure for checking exposure rate determines whether or not the shielding has been damaged. Use the procedure following initial receipt of the calibrator (see paragraph 3.2) and after any incident which could affect the shielding integrity (fire or drop, paragraphs 2.3 and 2.6).

2.2.5. Exposure Rate Check

2.2.5.1 Place a CD V-700 type survey meter near the radiation standard, in its storage condition (actuator knob in storage position). If dose rates greater than 2 mr/hr are encountered one foot or more from the standard take the following steps immediately:

2.2.5.1.1 Clear all personnel from the area where the calibrator is located, and survey the area to establish a 2 mr/hr isodose line. Isolate this area with barriers, ropes, or locked doors. Post radiation warning signs in accordance with Title 10, Part 20, Code of Federal Regulations.

2.2.5.1.2 Notify the following by telephone or telegraph:

A. Nucleonics Division
Technical Services
Office of Civil Defense
Department of the Army
The Pentagon, Washington, D.C. 20310
Phone: Area Code 202, 695-2519

B. Radiological Defense Officer of the appropriate OCD Regional Office.

2.2.5.2 If the radiation rate at a distance of one foot from the calibrator is less than 2 mr/hr in the storage condition, it may be assumed that all shielding is functioning properly. Perform a wipe test, according to paragraph 2.2.6 below.

2.2.6 Wipe Test Procedure

2.2.6.1 Loss of Cs-137 from the capsule is unlikely to occur during normal operating or storage conditions. The capsule is of a double welded stainless steel type with the radioactive material bound in a glass matrix. As established by federal regulations, the following wipe test should be performed at intervals not to exceed six (6) months, or promptly in the event of a significant environmental hazard. These tests must be conducted by, or under the direction of, a qualified health physicist or radiation protection officer.

2.2.6.1.1 Place the actuator knob in the storage position. Remove the four phillips head retainer screws (figure 6.1, item 42) and dust cover (12).

2.2.6.1.2 Using rubber or plastic gloves, moisten Whatman No. 50 (or equivalent) filter paper with isopropyl alcohol. Wipe the exposed section of the spherical source shield, the inside surface of the dust cover adjacent to the source opening, and the opening in the housing through which the actuator knob protrudes.

2.2.6.1.3 Check smear with CD V-700 for gross contamination. Let smear air-dry and evaluate the smear with an appropriate G-M counter or a gas-flow proportional counter at a known counting efficiency, E CPM/DPM (counts per minute/disintegrations per minute). Convert net count rate to units of microcuries using the appropriate E factor.

2.2.6.1.4 Compare the total result obtained from the wipe tests with the allowable limit of 0.005 microcurie activity. If the gross beta-gamma activity detected is greater than the 0.005 microcurie limit, immediately notify by telephone or telegraph the Nucleonics Division of the OCD and the Radiological Defense Officer of the appropriate OCD Regional Office (see paragraph 2.2.5.1.2). Place the calibrator in a sealed plastic bag to avoid spread of contamination. Check the general area where the calibrator was used and restrict all contaminated areas from use until cleaned. The requirements of Title 10, Part 20, Code of Federal Regulations, must be satisfied under

[illegible] directly by the Office of Civil Defense. Do not arrange to ship [illegible] Office of Civil Defense.

2.2.6.1.5 Record wipe test results in the permanent Wipe Test Record form, figure 2.2.

SEALED SOURCE WIPE TEST CERTIFICATE

The following CD V-797 Model No. 1 Cs-137 Radiation Standard Serial No. _____ was leak tested per paragraph 2.2.6 of the Instruction and Maintenance Manual on the following dates. The testing instrumentation was set up to detect the presence of less than 0.005 microcurie of removable contamination.

Contamination Level (MC)	Signature	Date

Figure 2.2 Wipe Test Record Form

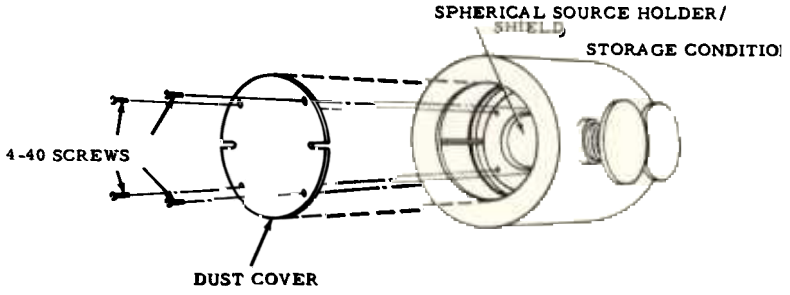


Figure 2.3 Removal of Dust Cover for Wipe Test

2.3 FIRE HAZARDS

2.3.1 Description of Hazards

2.3.1.1 Exposure of the radiation standard to fire may cause an emergency condition involving radiological hazards. A fire of short duration, temperature not exceeding 1000° F, will melt the nylon shield support sleeve bearings and impair source assembly rotation. The source capsule has been tested to determine that it will withstand this temperature. Since all of the shielding is made of sintered tungsten alloy, temperatures of up to 2000°F will not impair the shielding effectiveness. In the event of a prolonged high temperature fire, it is probable that the stainless steel capsule will melt, but will remain confined within the tungsten shield assembly.

2.3.1.2 If the radiation standard is exposed to fire or prolonged high temperatures, use the following procedures:

2.3.1.2.1 Extinguish the fire as quickly as possible, keeping the standard as cool as possible. Seal off air ducts to adjoining areas. Fight fire from the upwind direction.

2.3.1.2.2 The calibrator area may become contaminated with Cs-137 during and after the fire or heat exposure.

2.3.1.2.3 Notify the following by telephone or telegraph:

A. Nucleonics Division
Technical Services
Office of Civil Defense
Department of the Army
The Pentagon, Washington, D.C. 20310
Phone: Area Code 202, 695-2519

B. Radiological Defense Officer of the appropriate OCD Regional Office.

2.3.1.2.4 Within 30 days, submit a written report to:
Director, Division of Material Licensing
U.S. Atomic Energy Commission
Washington, D.C. 20545
or contact the appropriate AEC Regional Compliance Office as required. See paragraph 2.7.

2.3.2 Protection

2.3.2.1 The radiation standard should be stored in an area which is remote from combustible materials, sensitive radiation counting devices, assay areas, etc., and preferably one which has an overhead sprinkler system. Store the unit in the case provided, in an upright locked storage condition.

2.4 ELECTRICAL HAZARDS

2.4.1 Because the simulator must be connected to the polarization potential of a CD V-711 during the calibration process, a significant shock hazard exists if the case is opened. Numerous components, including the meter studs, are at a 400 to 500 volt potential relative to the instrument case. Suitable caution must be exercised during service or maintenance procedures.

2.5 ENVIRONMENTAL HAZARDS

2.5.1 Although the CD V-797 calibrator system is designed for field use, certain precautions should be taken to minimize service requirements.

2.5.1.1 Replace the plastic plug cap provided with the radiation standard before placing the standard on the ground. This will prevent sand and other abrasive materials from entering the cavity. If dusty or humid conditions exist, enclose the standard in a thin polyethylene bag in order to reduce contamination or corrosion. The unit should be returned to its storage container as soon as practical after each use.

2.5.1.2 Avoid insulator leakage in the connectors by replacing the protective covers on the simulator cable ends when they are not connected to the CD V-711.

2.5.1.3 Wipe the surface of the CD V-711 detector clean before using the radiation standard. This will avoid scratching the outer protective coating on the detector, and future corrosion problems.

2.5.1.4 The radiation standard may be placed on a detector in either the upright or horizontal mount configuration.

2.6 MOVING ACCIDENTS

2.6.1 Because of the added shielding and vibration protection which it affords, the CD V-797 should always be transported in the storage container provided. Under these conditions the calibrator will withstand the shock and vibration requirements of Specification MIL-E-17400E (NAVY), except for the five foot drop test. Most likely point of damage is the sensitive DC microammeter used in the simulator assembly. If the assembly is dropped from a height sufficient to damage the radioactive standard mechanism, exposure rates must be checked in accordance with paragraph 2.2 of this manual.

2.7 REPORTING REQUIREMENTS

2.7.1 In addition to the reports required by paragraphs 2.2 and 2.3, the notifications and reports as specified in Title 10, Part 20, Code of Federal Regulations, paragraphs 20.402 and 20.403, must be made immediately after a major incident, loss, or theft of the radioactive material, or for minor incidents within 24 hours, to:

A. The Director of the appropriate AEC Regional Compliance Office or appropriate state licensing agency,

B. Nucleonics Division
Technical Services
Office of Civil Defense
The Pentagon, Washington, D.C. 20310
Phone: Area Code 202, 695-6363, and

C. The Radiological Defense Officer of the appropriate OCD Regional Office.

SECTION 3.0
RECEIVING AND SHIPPING

3.1 UNPACKING AND HANDLING PROCEDURE

3.1.1 An authorized health physicist or radiation protection officer should receive the calibrator and check it as he would a consignment of radioactive materials.

WARNING

MEASURE THE DOSE RATE ON THE OUTER SURFACES OF THE SHIPPING CONTAINER IMMEDIATELY UPON ARRIVAL. A CD V-700 METER MAY BE USED FOR THIS SURVEY. EXPOSURE RATE MUST NOT EXCEED 2.0 MR/HR. IF IT IS HIGHER, IMMEDIATELY NOTIFY THE APPROPRIATE OCS PERSONNEL AS REQUIRED BY PARAGRAPH 2.2.5.

3.1.2 Remove the storage container from the shipping carton and unlock the storage cabinet. The keys to this case and to the radiation standard are fastened to the handle.

3.2 INSPECTION

3.2.1 Remove the radiation standard and simulator from the storage cabinet and unlock the standard. Check contents of the case to identify: two Tee adapters, two cable connector shields, one plastic strap and one instruction manual. Inspect the storage case, radiation standard, and simulator units for visible shipping damage. If damage is observed, notify the carrier within 48 hours to inspect the shipping carton and damaged contents if a claim is to be made. Rotation of the actuator handle out of storage position should not be possible until the standard is placed in position over a CD V-711 ion chamber and the clamp knob is rotated.

3.3 STORAGE REQUIREMENTS

3.3.1 The calibrator, located in its storage container, may be kept in any available storage area. Excessive humidity or dust should be avoided. For long term storage in adverse conditions, enclose the assembly in a plastic bag and tape it shut.

3.3.2 If more than one calibrator unit is stored in a given location, the area should be surveyed by a qualified health physicist or radiation protection officer to determine if the radiation level in the room exceeds 2 mr/hr. If it does, the area must be restricted and posted to comply with the requirements of Title 10, Part 20, Code of Federal Regulations, Sections 20.105 and 20.207.

3.4 PREPARATION FOR RESHIPMENT

3.4.1 If the calibrator must be shipped to the factory for service or wipe testing, the Radiological Defense Officer of the appropriate OCD Regional Office must be notified in writing.

3.4.2 Prepare the assembly for reshipment as follows:

3.4.2.1 Place radiation standard and simulator in the storage container with the actuator knob in locked storage condition.

Figure 3.1 Poison Label, Class D, Group 1

3.4.2.2 Carefully check the position of the cables and cable adapters to avoid damaged or missing parts on arrival. See figure 1.1 for location.

3.4.2.3 Lock the shipping container and send the keys under separate cover to consignee by registered mail.

3.4.2.4 Place a Class D Group 1 Poison label on the outer surface of the shipping container. See figure 3.1.

3.4.2.5 Place label showing consignee and destination of shipment on outer surface of shipping container, or attached to handle with wire if no overwrapper is used.

3.4.2.6 Shipment of this item must be in accordance with DOT requirements. DOT regulations applying to the shipment of this calibrator are published by the U.S. Government Printing Office, Washington, D.C. as a Code of Federal Regulations, Title 49, Transportation, parts 71 to 90. These regulations are also reprinted as tariffs for transportation of hazardous materials by the American Trucking Association (1616 P Street NW, Washington, D.C. 20036) and by the Bureau of Explosives, Association of American Railroads, 30 Church Street, New York, N.Y. 10007, as tariff No. 13, Publishing Interstate Commerce Regulations for Transportation of Explosives and Other Dangerous Articles. The consignor should assure that the consignee is appropriately licensed to receive the calibrator (receipt of requested copy of consignee's license or license number prior to release of shipment).

SECTION 4.0
CALIBRATOR OPERATION

4.1 GENERAL

4.1.1 The Model CD V-797 calibrator system will facilitate the following tests on CD V-711 Models 2, 2A, and Mark IV. Mark III units may be standardized on the 1.0 r/hr range only.

4.1.1.1 Cs-137 standardization of the 1 r/hr range.

4.1.1.2 Measurement of high megohm range multiplier resistors.

4.1.1.3 Determine proper polarization potential.

4.1.1.4 Test for ion chamber and cable leakage.

4.1.2 Before using the calibrator, verify that the inspection procedures listed in Section 3.2 have been performed. Using the decay factors given in Table 4.1, correct the standardized value marked on the serial number tag of the radiation standard. To determine the elapsed time in months, refer to the calibration date marked on the serial number tag.

Table 4.1
CD V-797 Source Decay Correction Factors

YEARS	MONTHS			
	0	3	6	9
0	1.0000	0.9935	0.9871	0.9806
1	0.9743	0.9679	0.9617	0.9554
2	0.9492	0.9430	0.9369	0.9308
3	0.9248	0.9188	0.9128	0.9069
4	0.9010	0.8951	0.8893	0.8836
5	0.8778	0.8721	0.8665	0.8608
6	0.8552	0.8497	0.8442	0.8387
7	0.8332	0.8278	0.8224	0.8171
8	0.8118	0.8065	0.8013	0.7961
9	0.7909	0.7858	0.7807	0.7756
10	0.7706	0.7656	0.7606	0.7557

4.2 STANDARDIZATION OF 1 R/HR RANGE

4.2.1 Before placing the radiation standard on a CD V-711 detector, clean the detector surface with a damp cloth to remove abrasive materials. Allow the CD V-711 metering unit to warm up in the zero position for several minutes before selecting the 1 r/hr range. If excessive zero drift is observed, the batteries may need to be replaced.

CAUTION

ALWAYS ROTATE THE CLAMP KNOB TO THE MAXIMUM COUNTER-CLOCKWISE POSITION BEFORE PLACING THE STANDARD ON A DETECTOR. FAILURE TO OBSERVE THIS CAUTION WILL RESULT IN DAMAGE TO THE DETECTOR SURFACE.

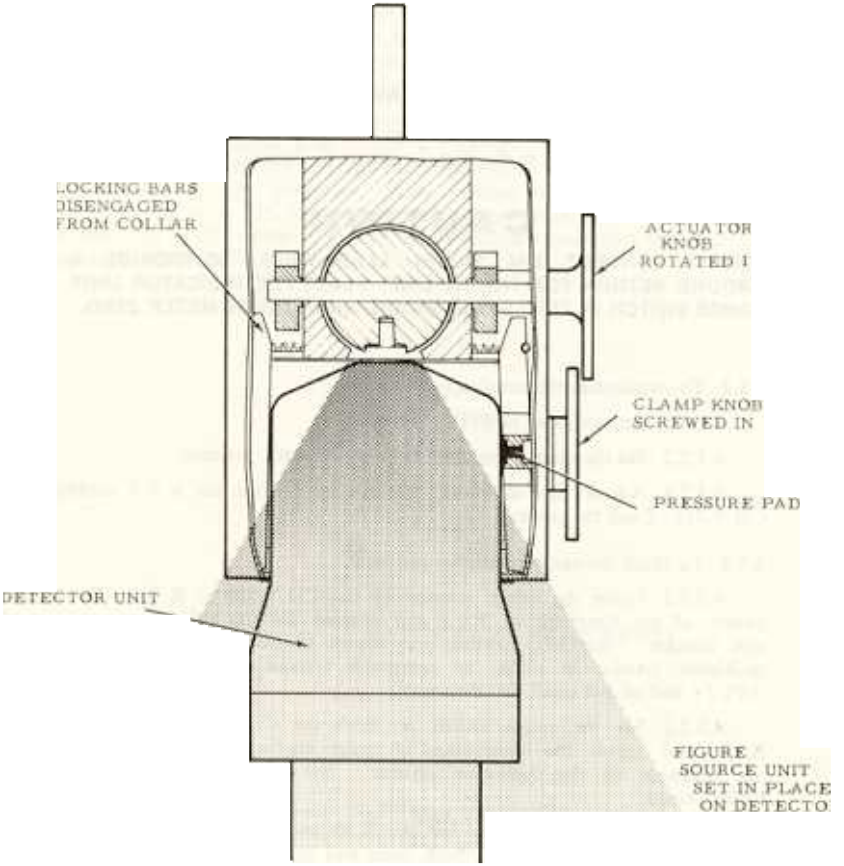


Figure 4.1 Source Unit Set in Place on Detector

4.2.2 Place the radiation standard over the detector housing with the upper surface of the detector against the dust cover, as indicated in figure 4.1. Tighten the clamp knob until the actuator is released. Remove the actuator lock, and rotate the actuator knob to its calibrate position.

CAUTION

THE OPERATOR MUST STAND AT LEAST THREE FEET FROM THE RADIATION STANDARD DURING CALIBRATION. SEE FIGURE 2.1.

4.2.3 Adjust the sensitivity control on the CD V-711 until the indicator uni with a corrected value of the radiation standard.

4.2.4 To remove the radiation standard, rotate the actuator knob to its storage position and replace the lock. Return the clamp knob to maximum counterclockwise before lifting the standard from the detector housing.

4.3 MEASUREMENT OF RANGE MULTIPLIER RESISTORS

4.3.1 Disconnect the detector cables from the CD V-711 indicator unit, and connect the simulator signal and HV cables to the unit as shown in figure 1.3.

CAUTION

ALWAYS CONNECT THE SIGNAL LEAD FIRST, TO PROVIDE A GROUND RETURN FOR THE HV LINE. PLACE THE INDICATOR UNIT RANGE SWITCH IN ZERO SET POSITION, AND ADJUST METER ZERO.

4.3.2 To standardize the simulator:

4.3.2.1 Set simulator to STD position.

4.3.2.2 Set the selector on the CD V-711 to X 0.1 position.

4.3.2.3 Adjust the simulator Standardize control for a 0.5 reading on the CD V-711. Lock the control.

4.3.3 To check the range multiplier resistors:

4.3.3.1 Leave the range selector of the CD V-711 at X 0.1. Set the range switch of the simulator at X0.1 and observe the CD V-711 meter reading after one minute; the delay permits any stored insulation charges to decay. If the multiplier resistor is within an acceptable tolerance, the meter should read 0.5 ±5% (± half of one small dial division).

4.3.3.2 Set the range switch on both the CD V-711 and the simulator at X1.0, and repeat the observation of meter reading on the CD V-711 to define the tolerance of the multiplier resistor. No delay is required for this, or any higher, range.

4.3.3.3 Repeat the above for the X10 and X100 ranges, setting the range switch for the same range on both units and checking the CD V-711 meter for a tolerance indication.

4.3.3.4 If any one or more of the multiplier resistors are out of tolerance, compute the correction factor for that range. It is assumed that the correction factor for the X0.1 range is unity, since this has been source calibrated. The correction factor for any other range is a ratio of the meter readings. For example, if the meter reads 0.52 for the X0.1 range, and 0.58 for the X1.0 range, the correction factor for the X1.0 range would be 0.52 ÷ 0.58, which is 0.896.

4.4 POLARIZATION POTENTIAL

4.4.1 To check the polarization potential, set the simulator selector switch to its polarization pot position. The simulator meter should indicate within the red area to indicate that the potential is within acceptable tolerance limits. For CD V-711 Models 2 and 2A, the polarization pot toggle switch will be at its + position for the proper polarity; for Mark IV instruments, the toggle will be at −. The simulator is not designed to check polarization potential for Mark III instruments.

4.5 LEAKAGE TESTING

4.5.1 Electrical leakage in either the signal or the HV cables to the ion chamber may be isolated as follows:

4.5.1.1 Repeat paragraphs 4.3.2 and 4.3.3.1 above, for an approximate half-scale indication on the CD V-711 meter, using the X 0.1 range.

4.5.1.2 Connect the signal cable from the detector to the unused Tee connector at the CD V-711 (see figure 4.2). Any variations in the meter reading are caused by leakage current in this cable, and the approximate error can be calculated as in 4.3.3.4 above. Disconnect the signal cable from the Tee.

4.5.1.3 Set the simulator selector switch at polarization pot, with the toggle switch set for the proper polarity (see 4.4 above). Connect the high voltage cable from the detector to the unused Tee connector at the CD V-711 (see figure 4.2). Any change in the simulator meter reading represents a leakage condition. Normally, up to a 10% loss of high voltage will have little effect on performance of the CD V-711 unless there is a fluctuating component sufficient to cause a significant variation in the reading.

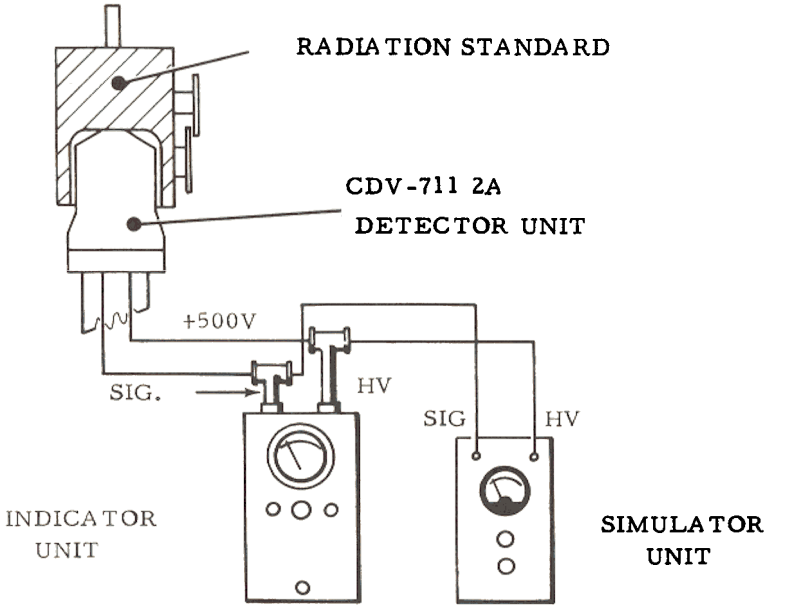


Figure 4.2 Calibration Connections

SECTION 5.0
OPERATOR'S MAINTENANCE

5.1 GENERAL

5.1.1 The calibrator system normally requires only the limited operator maintenance given in this section. Because radioactive cesium is contained in the radiation standard unit, disassembly of this unit should be performed only by a trained radiological technician. The simulator section may be serviced by any qualified electronics technician.

5.2 PREVENTIVE MAINTENANCE

5.2.1 Periodic Radiological Maintenance

5.2.1.1 Perform wipe tests per paragraph 2.2.6 at intervals not to exceed six (6) months, or more frequently under the direction of a qualified health physicist or radiation protection officer. Keep a record of these tests in figure 2.2.

5.2.2 Periodic Mechanical Maintenance

5.2.2.1 Perform the following maintenance procedures at intervals as determined by the frequency of use of the CD V-797.

5.2.2.2 Always replace the plastic plug in the side wall of the radiation standard assembly during storage or transit, to keep dust out of the mechanism.

5.2.2.3 Approximately each 100 cycles of operation, blow dust out of the mechanism with clean dry compressed air, and spray both locking bar surfaces with Dupont Teflon Slip Spray or an equivalent dry lubricant.

5.2.2.4 Apply a small amount of cup grease to the threaded portion of the clamp knob as required.

5.2.3 Ball Vlier Adjustment

5.2.3.1 Adjustment of the ball vlier spring tension may be required. If rotation of the actuator knob does not provide a positive and repeatable instrument reading, remove the plastic plug (17, figure 6.1) from the housing and adjust the vlier (19) position with a flat blade screwdriver. If sufficient adjustment is not possible, return the assembly to the manufacturer for repair.

5.2.4 Simulator Maintenance

5.2.4.1 Operator maintenance of the simulator consists of correcting the meter zero indication, as required, and periodically cleaning the cable connectors. Cover the connectors at all times when they are not in use, using the metal caps provided. To clean the connector insulation, use a cotton swab moistened with pure isopropyl alcohol. Remove lint with compressed air or nitrogen.

5.3 CORRECTIVE MAINTENANCE

5.3.1 The trouble shooting chart, Table 5.1, includes some possible service problems and the required corrective action. See Section 6 for a list of replacement parts.

Table 5.1
Trouble Shooting Chart

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
Actuator knob fails to index properly.	Ball vlier improperly adjusted.	See 5.2.3. Try lubricant and readjust after the plastic plug is removed.
Radiation standard mars detector surfaces.	Worn plastic sleeve on lever locking bars.	Cover sleeve break with wrap of ½" x 0.005" teflon tape.
Radiation standard does not properly grip detector surface.	Worn out or greasy rubber bumper, or broken spring.	Clean bumper with ethylene dichloride or replace. Replace broken spring.
CD V-711 will not standardize to the corrected radiation standard value.	Defective CD V-711. Broken or leaking detector signal cable.	Check hi-meg resistors and cable leakage (see 4.3 and 4.5). Clean or replace cable assembly.
Half-scale readings not obtainable using simulator standardize range.	Shorted or broken simulator signal cable. Insufficient CD V-711 HV, or wrong polarity. Incorrect sensitivity control settings. Hi-meg resistor error.	Check cable continuity. Measure polarize potential. Adjust polarity switch.

SECTION 6.0
PARTS LIST

6.1 GENERAL

6.1.1 The following parts lists provide a comprehensive identification of the component parts of the Calibrator. Parts of the radiation standard which are marked with an asterisk (*) are for reference only, and must not be removed or replaced without specific written instruction from the Nucleonics Division, Technical Services, Office of Civil Defense, Department of the Army, The Pentagon, Washington, D.C. Each part so marked can only be removed or replaced under conditions which constitute hazardous personnel exposure to the Cs-137 source.

6.1.2 Table 6.1, Parts List for the Radiation Standard Assembly, includes reference numbers as they appear on the assembly drawing shown in figure 6.1. For convenience, the four views which comprise figure 6.1 are separated into four plates.

6.1.3 Table 6.2, Parts List for the Simulator Assembly, includes schematic symbol reference numbers as applicable. The symbol numbers appear in the overall schematic, figure 6.2.

6.1.4 Table 6.3, Parts List for Miscellaneous Items, includes the typical replacement parts other than those which are specifically associated with the radiation standard or simulator assembly.

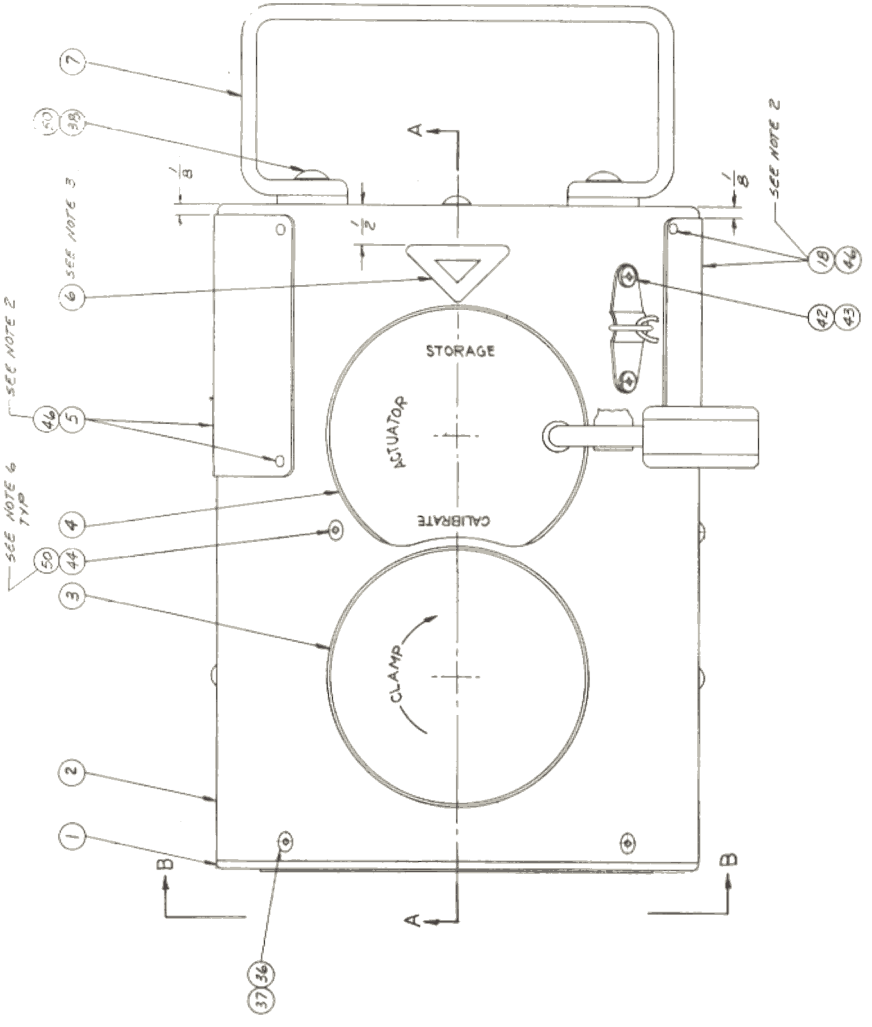


Figure 6.1
Radiation Standard Assembly, Mechanical Detail

(Part 1 of 4)

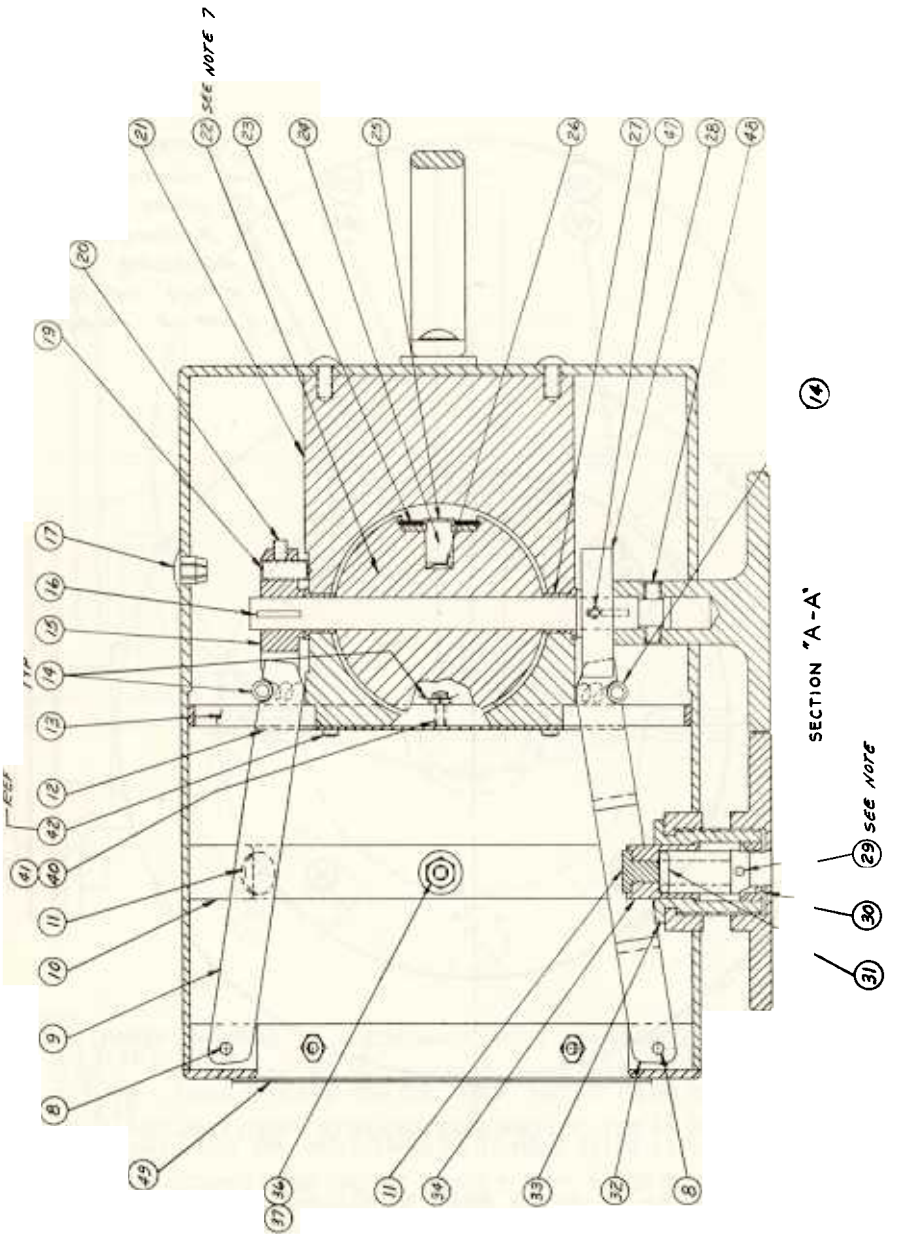


Figure 6.1
Radiation Standard Assembly, Mechanical Detail

(Part 2 of 4)

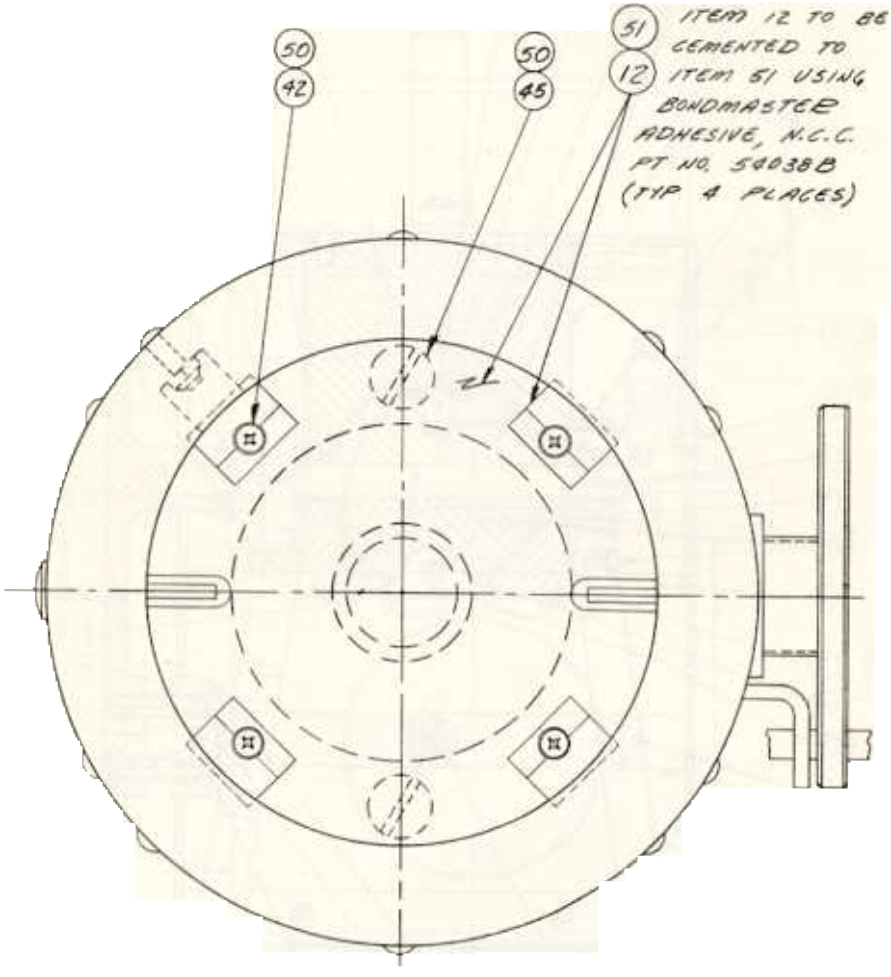
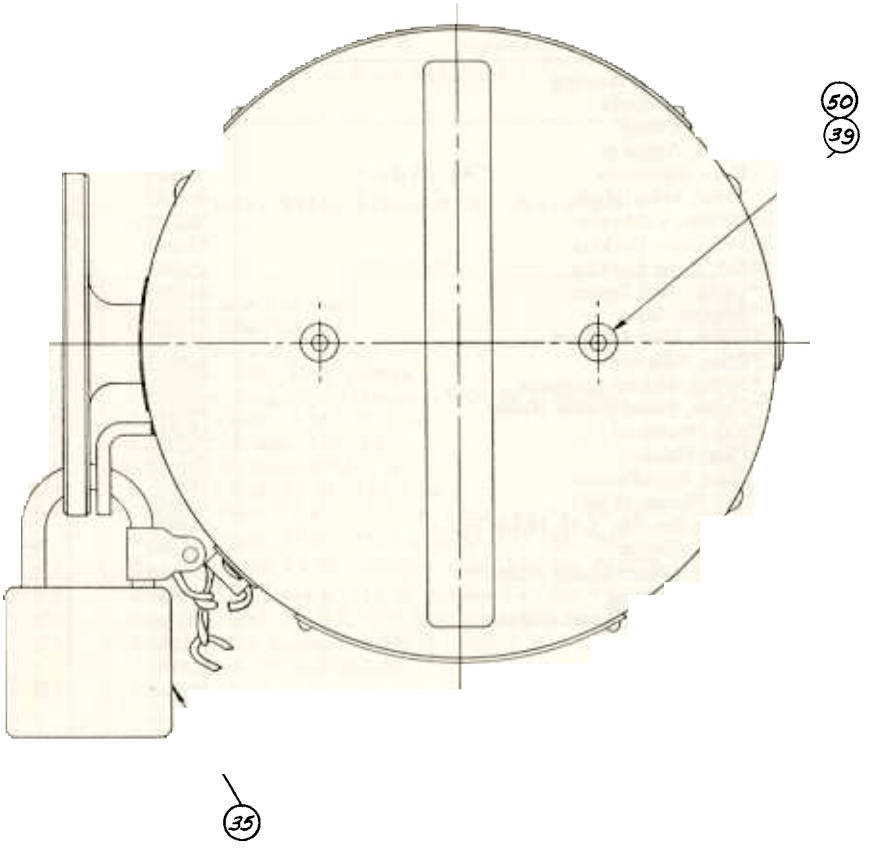


Figure 6.1
Radiation Standard Assembly, Mechanical Detail

(Part 3 of 4)



NOTES
1. INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL-D-70327.
2. ITEM 5 AND ITEM 18 TO BE CENTERED AND LOCATED AS SHOWN. AFTER ASSEMBLY, DRILL 8 HOLES .086 DIA. THRU. SECURE ITEMS 5 AND 18 USING ITEM 46.
3. AFTER ASSEMBLY ITEM 6 TO BE CENTERED AND LOCATED AS SHOWN.
4. DRILL .094—.097 DIA. HOLE THRU PILOT HOLE AFTER ASSY. AND PIN WITH ITEM 29.
5. FINISH ON SCREWS TO BE CAD PLT. CLASS 3, TYPE II PER QQ-P-416.
6. APPLY ITEM 50 TO THREADS OF ITEMS 38, 39, 42, 44, & 45 AT TIME OF ASSEMBLY.
7. DURING ASSEMBLING OF ITEM 15 AND ITEM 28 TO ITEM 22, THE SHAFT OF (ITEM 22) IS TO BE COUNTERSUNK $^{3}/_{32}$ DEEP ACCURATELY FOR THE SET SCREWS (ITEM 47) WHICH ARE USED TO SECURE ITEMS 15 & 28.

Figure 6.1

Radiation Standard Assembly, Mechanical Detail

(Part 4 of 4)

Table 6.1
Parts List, Radiation Standard Assembly

Note: All items identified with an asterisk (*) are not to be removed or replaced without the specific instructions of the Nucleonics Division, Technical Services, Office of Civil Defense, Department of the Army, The Pentagon, Washington, D.C.

Reference (fig 6.1)	Description	Nuclear-Chicago Part No.	Qty.
1	Ring, Shield Housing	467643	1
2	*Housing, Shield	496764	1
3	Knob, Clamp	489193	1
4	*Knob, Actuator	489203	1
5	Plate, Operation	704063	1
6	Label, Index Mark	704042	1
7	Handle, Calibrator	508243	1
8	*Pin, Lever Locking	534242	2
9	*Bar, Lever Locking	456093	1
10	*Collar, Half Spacer	467633	2
11	*Bumper, Stem	546522	3
12	*Cover, Dust Cushion	541028	1
13	*Plate, Retainer	440653	1
14	*Spring, Helical Extension	549642	2
15	*Collar, Shield Source Holder	467612	1
16	*Key, Woodruff	571852	2
17	Plug, Plastic	672732	1
18	Plate, Identification	704053	1
19	*Ball Plunger (Vlier)	518912	1
20	*Screw, Set, No. 8-32, Nylon Tip	518902	1
21	*Shield, Source	793694	1
22	*Shield, Sphere Source Holder	793684	1
23	*Ring, Retaining	762682	1
24	*15 mc Cs-137 Source Capsule	696192	1
25	*Cap, Source	561672	1
26	*Washer, Spring	521902	1
27	*Bearing, Nyliner	539620	2
28	*Collar, Shield Spacer	467622	1
29	Pin, Groove	534252	1
30	Cap, Spring	561622	1
31	Spring, Plunger	549652	1
32	*Bracket, Lever Locking	412133	1
33	Collar, Spring Clamp	467602	1
34	Collar, Plunger Clamp	467592	1
35	Padlock with Chain and Keys	510623	1
36	Screw, Hex Socket Button Hd Cap, No. 6-32 UNC-2A x 3/8" lg, per QQ-S-624	6-32x3/8	10
37	Nut, Self Locking, MS-20365-632		10
38	Screw, Hex Socket Button Hd Cap No. 1/4-20 UNC-2A x 3/8" lg, per QQ-S-624	1/4-20x3/8	2
39	Screw, Hex Socket Button Hd Cap, No. 10-32 UNC x 3/8" lg, per QQ-S-624	10-32x3/8	2
40	Screw, Mach Phil Pan Hd, No. 4-40 UNC-2A x 1/2" lg	MS35206-217	2
41	Nut, Plain Hex No. 4-40 NC-2B	MS35649-42	2
42	Screw, Mach Phil Pan Hd, No. 4-40 UNC-2A x 1/4" lg	MS35206-213	6
43	Washer, Lock, Int Tooth, No. 4	MS35333-36	2
44	Screw, Hex Socket Button Hd Cap, No. 8-32 UNC-2A x 3/8" lg, per QQ-S-624	8-32x3/8	3
45	Screw, Mach, Flat Hd Slotted, 1/4-20 UNC x 4" lg, per QQ-S-624	1/4-20x4	2
46	Screw, Drive, Rd Hd, Type U, No. 2x3/8"	MS21318-14	8
47	Screw, Socket Set, Hex, No. 10-32 UNF-3A, 3/8" lg, cup point	MS18063-25	2

Table 6.1
Parts List, Radiation Standard Assembly (cont'd)

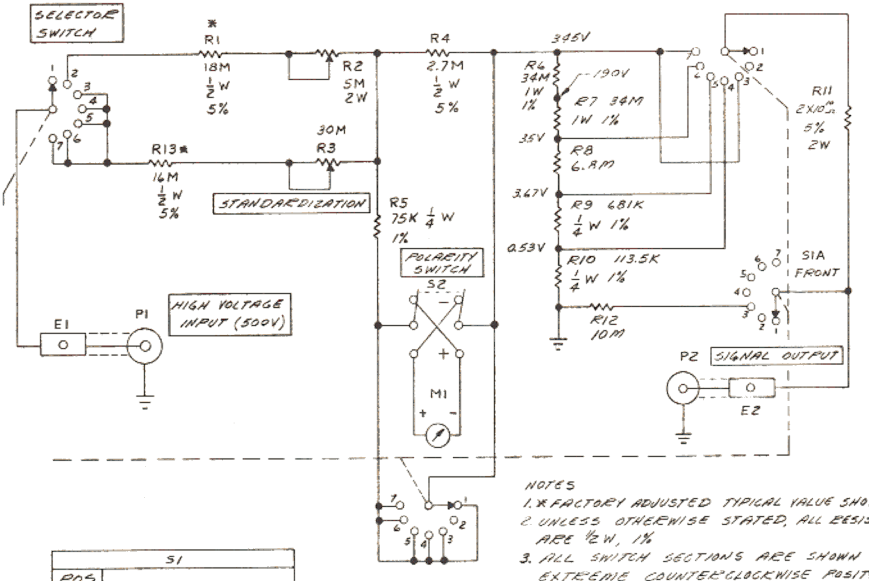
Reference (fig 6.1)	Description	Nuclear-Chicago Part No.	Qty.
48	Screw, Socket Set, Hex, No. 10-32 UNF-3A, 3/16" lg, cup point	MS18063-8	2
49	Caplug, Tapered	561773	1
50	Liquid Lock Sealant, Type B per MIL-S-22473	No. 500	AR
51	*Spacer, Block	529771	4

Table 6.2
Parts List, Simulator Assembly

Symbol (see fig. 6.2)	Description	Nuclear-Chicago Part No.
E1	Coaxial Cable End Seal	MX-1530/U
E2	Coaxial Cable End Seal	MX-1530/U
M1	Meter, Electrical Indication	607364
P1	Connector, Plug, High Voltage	UG-932A/U
P2	Connector, Plug, Signal (Requires UG-176/U adapter)	PL-259
R1	Resistor, Fixed, 18 M ±5% ¼ w	RC20GF186J
R2	Resistor, Variable, 5 M, 2 w	305050
R3	Resistor, Variable, 30 M, 1 w	356453
R4	Resistor, Fixed, 2.7 M, ±5% ½ w	RC20GF275J
R5	Resistor, Fixed, 75 K, ±1% ¼ w, Class T-O No. PME65	
R6, R7	Resistor, Fixed, 34 M ±1% 1 w, Class T-O No. PME75	
R8	Resistor, Fixed, 6.8 M ±1% ½ w, Class T-O No. PME70	
R9	Resistor, Fixed, 681 K ±1% ¼ w, Class T-O No. PME65	
R10	Resistor, Fixed, 113.5 K ±1% ¼ w, Class T-O No. PME65	
R11	Resistor, High Voltage, 20,000 M ±20% 2 w, Part No. MVX-2 (07716)	
R12	Resistor, Fixed, 10 M ± 1% ½ w, Class T-O No. PME70	
R13	Resistor, Fixed, 16 M ±5% ½ w	RC20GF166J
S1	Switch, Rotary	635864
S2	Switch, Toggle, DPDT	638000
	Cable, Coaxial, Amphenol 21-541 (Signal)	
	Cable, Coaxial, RG-59/U (High Voltage)	
	Case, Simulator	496774
	Cover, Simulator, Screened	484944
	Knob-Lock, Black STANDARDIZE	489242
	Gasket, Top Cover	54013C
	Boot, Switch, Toggle	MIL-B-5423/4
	Knob, Control	MS91528-IN2B
	Knob, Pointer	MS91528-IP2B

Table 6.3
Parts List, Miscellaneous Items

Description	Nuclear-Chicago Part No.
Strap, Simulator	571862
Case, Transit	496814
Connector, Tee, for Signal Cable (Amphenol 83-1T)	
Connector, Tee, for High Voltage Cable (Dage 2940-1)	



S1	
POS	
1	OFF
2	POLARIZATION POT
3	STD
4	X.1
5	X1
6	X10
7	X100

NOTES

1. * FACTORY ADJUSTED TYPICAL VALUE SHOWN.
2. UNLESS OTHERWISE STATED, ALL RESISTORS ARE 1/2 W, 1%
3. ALL SWITCH SECTIONS ARE SHOWN IN EXTREME COUNTERCLOCKWISE POSITION.
4. TEST CONDITIONS:
   ALL MEASUREMENTS ARE TAKEN WITH A KEITHLEY 610B ELECTROMETER WITH X10 PROBE AND THE CONTROLS SET AS FOLLOWS. R3 ADJUSTED FOR A STD OUTPUT OF 0.5 R/hr.
   SELECTOR SWITCH (S1) IN THE STANDARDIZATION POSITION